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ABSTRACT

This report describes the methods, developed by the American Institute of Physics in cooperation with Engineering Index, Inc., by which both organizations could reduce costs by eliminating duplication of keyboarding and indexing. The three sets of problems that confronted the interchange of their data bases (classification and indexing, formats, data elements, and special characters) are noted, and the means by which they were resolved are explained. Included in the report are three tables that present a comparative study of special characters used by the two data bases, a data element identification log, and data element descriptions. A final section describes the format conversion for tape exchanges between AIP and Ei. Appended are the processor flowchart, the AIP-Ei converter fowchart, the Physics and Astronomy Classification Scheme (PACS) to Subject Headings for the Engineering (SHE) mapping table, the PACS optics supplement, and a description of the conversion of AIP-Ei indexing for optics. (JD)

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FINAL REPORT

INTERCHANGE OF DATA BASES

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INTERCHANGE OF DATA BASES

Abstract

The American Institute of Physics, in cooperation with Engineering Index, Inc., developed methods by which both organizations could reduce costs by eliminating duplication of keyboarding and indexing. Sharing of the resources of the two organizations, by interchanging data bases, would improve the utilization of the computer-readable data bases and the services derived from them. Compatibility of internal standards and practices among four abstracting and indexing services, American Institute of Physics, Biosciences Information Service of Biological Abstracts, Chemical Abstracts Service and Engineering Index, Inc., was also studied. A successful interchange of indexed abstracts on tape was completed between Engineering Index, Inc., and the American Institute of Physics.

SUMMARY

The American Institute of Physics (AIP) and Engineering Index, Inc. (Ei) received a grant from the National Science Foundation to develop methods by which both organizations could reduce their input costs by eliminating duplication of intellectual effort and processing. A similar grant from the National Science Foundation had been given to Chemical Abstracts Service (CAS) and Biosciences Information Service of Biological Abstracts (BIOSIS). All four services have computerized data bases, which are used to produce bibliographic tape services and various computer-photocomposed printed products. It was obviously desirable for the four services to cooperate on the studies, since this would ensure that no changes would be made in the practices of either pair of services which would make them more incompatible with the other services.

Grant funds did not cover product development, but it was expected that interchange capability would allow AIP and Ei to work together on the production of new services in the areas where engineering and physics overlap. These overlaps are generally in the area of applied science, especially acoustics, optics, solid state science, and instrumentation. At the present time, Ei chooses about 5,000 items per year from journals and conference proceedings published by AIP. For certain of these journals, Ei includes complete journal issues; for other journals, articles are selected on the basis of subject content. Using a programmed option of choosing articles by CODEN or by classification, AIP could select items for Ei and deliver them on magnetic tape, indexed and formatted as specified by Ei; Ei would thus save on keyboarding and indexing costs. On an exchange basis, AIP would be able to increase its coverage by

acquiring material not currently processed by AIP, including technical reports, standards, and selected books.

In order to make such an interchange possible, it was necessary to solve three sets of problems:

1. Classification and Indexing

AIP uses a four-level hierarchical classification scheme, the Physics and Astronomy Classification Scheme (PACS) (1). Discussions have been underway for several years with Physics Abstracts, Physikalische Berichte and Bulletin Signaletique concerning adoption of a version of PACS as an international classification scheme for physics; this made it essential not to make substantive changes to PACS which would preclude its use on an international level. PACS terms used in SPIN (AIP's monthly magnetic tape service), journal indexes, and Current Physics Index generally represent properties and methods, with little emphasis on materials. Up to four PACS terms may be assigned to an article.

Ei uses Subject Headings for Engineering (SHE) (2) for indexing purposes. SHE is a controlled vocabulary, with terms, phrases and concepts listed alphabetically. Indexing usually consists of one Main Heading, which reflects the primary emphasis of the original author, which may be modified by a subheading. As many as five more Main Heading-Subheading combinations may be included as cross-references. Main Headings include materials, as well as processes, systems, etc.

The Main Headings and subheadings are used in EI's COMPENDEX tape service, and EI monthly and annual. EI editors also assign CAL codes to each article; these are three-digit numbers which subdivide the coverage of EI into almost two hundred subsets.

Interchanging the two index systems was considered to be the most difficult problem to solve, since we were attempting to correlate a hierarchical structure with a non-hierarchical alphabetized list. In addition, it was necessary to map certain areas from one vocabulary into a more expanded set in the other vocabulary; for example, EI has a Main Heading of "Physics," which could be said to subsume the entire journal output of the AIP. A computer program was developed and tested which was capable of mapping 80% of PACS into SHE; the remaining 20% required manual intervention by AIP indexers. It is technically feasible to map EI Main Headings and subheadings into the corresponding PACS codes, but it proved to be more economical to have EI indexers enter the appropriate PACS codes because of the cost of using the computer to match words strings from heads and subheads into PACS.

Overall, about three-quarters of the indexing performed by each service was acceptable to the other. This is a remarkable level of consistency, in view of results of previous experiments on indexing consistency (3,4,5).

2. Formats

Both AIP and Ei have developed formats for magnetic tape which are based on internal needs and multiple use of the data base. Each organization has an input format which grew out of its requirements for simplicity and economy of keyboarding for a particular kind of input, and an output format which is designed to accomodate a variety of products and services, including abstracts journals, primary journal heads, tapes for SDI services, etc. Both organizations have invested substantial amounts of time and money in programming for magnetic tape services and computer-photocomposition which are based on their input and output formats. Because changes in format would involve many man-years of reprogramming for production of each service's products, it was not practical for either organization to change over to the other's input or output formats.

AIP maintains its own staff of programmers for regular programming and computer-photocomposition, but Ei relies on an outside service bureau for programming and computer time. AIP, therefore, could accept and manipulate other formats more readily than Ei; Ei would require a format which would allow it to merge an AIP computer tape into its production system with a minimum of reprogramming and handling by its service bureau. It was agreed that a format should be chosen for information interchange which was readily convertible, and which could be adapted as needed by each service. It was decided to work within the framework of the ANSI format for bibliographic information interchange on magnetic tape (6); a version of this format has also been studied by the UNSIST-ICSU/AB group as a possible international standard for information interchange (7). AIP had no difficulty in converting from this format, which uses a directory at the beginning of each record on the tape, to the AIP standard format, which tags each data element in the record but has no directory. Ei already produces a COMPENDEX-ANSI tape as output; they were able to integrate the experimental tapes produced by AIP into their production system without any problem.

3. Data Elements and Special Characters

All of the major abstracting and indexing (a and i) services use a basic set of data elements. As a minimum, these include title, author, bibliographic citation (journal, volume, page, year) and indexing information. Each a and i service also adds additional information appropriate to its discipline, coverage, and products; these may include items such as chemical compound information, language of article, availability of document, etc. However, the content of the data element field varies with the different a and i organizations; this is related to the archival nature of the material, constraints imposed by publishing practices, economic considerations (such as the amount of space which can be devoted to a particular data element in a printed product), and style (e.g., whether periods are used after abbreviations).

A related problem is the method of handling scientific symbols and other special characters on input and output tapes, where the same symbols have different nomenclature in different systems. After a preliminary analysis of data elements, data element content, and special characters used by AIP and Ei, the study was extended to include CAS and BIOSIS.

Conversion from one set of special characters to the set used by another service presents no special problems, since each service regards its set as open-ended to additional symbols. Handling of data element content presents a more difficult problem to resolve; it is possible to truncate information, add or eliminate punctuation, or change capitalization, but it is not so easy to add information which was not captured initially (for example, an author's first name). An analysis of the practices of each service is presented later in this report, although no changes in internal practices resulted from the study.

Details of the solutions of these three problems are given in the succeeding chapters of this report. The project concluded with the successful interchange of computer tapes between AIP and EI, containing indexed abstracts from selected journals for inclusion in each other's services and products.

CLASSIFICATION AND INDEXING

Introduction

Transmittal of classification or indexing information between two systems is one of the most difficult and elusive problems in any exchange of bibliographic information. Even when the same schemes for classification or indexing are used on both sides of the exchange, so that no conversion is necessary, difficulties are bound to occur; exchange programs have failed because of incompatible usage or interpretation of the same classification system by each of the partners to the exchange. Notwithstanding the generally discouraging precedents, an attempt was made within the framework of this grant to provide, as much as possible, automatically converted indexing information in the transmittal process, thus treating the coded elements of indexing information as much as possible the way all the other data elements were to be treated. By maximizing the automatic conversion, maximum savings from an exchange program could be achieved.

PACS is a hierarchical classification scheme which contains roughly 2000 physics related headings distributed in four levels of a hierarchical tree. Each heading is identified by a six character code, the sixth being a check-character computable from the other five and used to detect any illegitimate assignments. The first two digits of a PACS code describe the first two levels of the hierarchy, which comprise 60 to 70 chapters devoted to well-defined areas of activity or subdisciplines. The next two digits give the third level of the hierarchy and the fifth character, usually an upper-case letter, gives the fourth level. The third and fourth levels describe well defined problems or applications within each of the subdisciplines. A total of four codes can be assigned to a paper; the system was designed for use by inexperienced indexers, e.g., the authors of the papers themselves. The system does not require special training, since finding the appropriate code requires a limited number of decision points, each comprising a choice between a small number of alternatives displayed in a logical order. The same logical ordering is used for output purposes in the display of printed indexes and current awareness journals.

Conversion of Classification-Indexing Information

The following are among the factors to be considered in the design of a system of conversion of indexing information:

1) Scopes of the coverage of the data bases (in our case, physics vs. engineering)
2) Level of user interest in a given subject (in this case, physicist's vs. engineer's levels of interest)
3) Structures of the classification and indexing systems (for example, hierarchical vs. thesaurus, fixed vs. coordinated, etc.)

SHE is an alphabetical list of terms currently used by Ei indexers as a controlled vocabulary for the characterization of transdisciplinary literature in engineering and related sciences. SHE contains in excess of 12,000 authorized permutations of HEADINGS and specifically assigned or allowable subheadings. Ei editors select the HEADING that most specifically reflects the emphasis given the subject by the author. They may name "things" (tangible and/or measurable, or conceptual) or "processes" (physical or intellectual). Subheadings in SHE are listed below each HEADING in alphabetical order, and are related to them in a variety of ways (part of, application of, property of, phenomenon of, environment of, manufacturer of, operation performed on, etc.). Profuse cross references and scope notes aid the user of SHE, limiting the meaning of headings, calling attention to other related or more specific headings or providing special indexing instructions. The latter allows indexers to synthesize "ad hoc" HEADINGS or HEADING-Subject Heading combinations, so that, while most SHE entries are fixed in form, the system is not a completely closed authority list. Indexers select one HEADING-Subheading combination for each paper to characterize the main scope of the work, and to be used for printed products; the other selections are used to form cross-references and for machine retrieval. Indexers also assign CAL codes, a form of numerical classification stemming from the former Card-A-Lert service. CAL codes are almost uniquely determined by the selected headings, with some occasional flexibility left to the indexer through indexing instructions listed in SHE. Use of the SHE system requires trained and experienced personnel, knowledgeable in its subtleties and intricacies.

The scopes of the data bases are determined by the missions of each of the services to which they belong, the physics and engineering communities. The reciprocal relationship between any two disciplines is such that one can define these areas for their scopes: an area of common interest or overlap and two areas of disjoint interest. The existence of a sizable area of overlap justifies an exchange program between the two data bases.

The scope of coverage of a given data base is defined by the set of rules that determines whether a given published document will or will not be entered in the data base. The simplest such rule is the a-priori decision to process a given list of journals cover-to-cover. The simplest target for the exchange program is the set of journals that are processed cover-to-cover simultaneously in both data bases. However, the exchange of those documents which are in journals treated cover-to-cover by only one of the services may be more rewarding. The saving to the other service of the scanning of many journals to get these items of occasional interest generates many of the benefits of an exchange arrangement, resulting in savings of time and effort and in enhancement of the quality of the data base through improved coverage.

When a needed document does not fall within the cover-to-cover rule, the decision for its inclusion is made on the basis of a set of subject-oriented scope rules. Given the generally terse nature of these rules, it was felt that attempting mechanized retrieval of such documents by means of a search profile would give rough results and be, at best, a first screening of the documents. Another argument also weighed against the use of a search profile to determine the set of documents to be transferred. It was feared that aspects of the document which may be of interest to the other data base may have little or no weight within the scope of the first data base, and thus, may be masked or missing in the indexing done there. These papers may not be able to trigger the search profile at all, or may not do it with any substantial weight, so that any system of weights devised to improve the search profile may not be reliable. It was felt that, at least with the present state of the art, it was best to entrust scope determination, i.e., document selection for data base transfer, to the indexer himself. This was one more argument in favor of preprocessing of the documents to be transferred at the point of origin, rather than postprocessing at the recipient's end, a choice that influenced all the other stages of the design of the system.

Depth of Indexing

When the subject coverage of two services is compared, we can distinguish three areas: one of commonality or overlap, where the interest of both services coincides in scope and degree, and two adjacent areas where, respectively, the interest of one of the services on the subject far surpasses in scope and degree that of the other. The translation or mapping of the classification or indexing systems between the two services should not present too many difficulties for the areas of commonality, because parallel interests should have led to equivalent systems for the intellectual description of such area of commonality, or because such a system could be worked out through a negotiating process. An example of such an area of commonality is "Fluid Dynamics", Section 45 PACS and the MAIN HEADING: "Flow and of Fluids" in SHE. The approximately 40 subheadings of the latter are almost an alphabetical rearrangement of about the same number of subheadings of the former, although the mapping process could be made easier by the removal of some discrepancies and the adoption of a uniform terminology.

It is in the two disjoint areas beyond the area of commonality that we may expect to encounter most of the difficulties. We can assume that such areas are described in both systems, but that the degree of detail given to the description is what differs. The difference in degree of detail of the description may vary, with either service having a greater number of subdivisions. An example is the entry "PHYSICS-High Energy" which in SHE subsumes nearly all the material of Sections 11, 12, 13 and 14 in PACS, roughly 120 subheadings. Conversely, the entry in PACS 89.40. Transportation corresponds to about 100 obvious entries in SHE, and many more possible permutations.

Such areas of non-overlap do not actually create much of a practical problem. Supplementing the missing information does not impose much of a burden on each of the services because the occurrence of such instances is relatively rare. The material to which it applies was selected out of the data base by the coverage criteria of the respective services; therefore, one possible solution to the different scope of the classification systems involved in the exchange is extension of each classification scheme. Adequate supplements to each classification system will give the missing detail found in the other system, but such an extended system will be used relatively seldom, given the nature of the material normally covered by the service.

The solution just proposed, however, requires that the various subject categories used within each of the classification or indexing systems should be ordered according to their relationship of depth or detail, a feature that is already built into the hierachical classification systems, and to some degree into the thesauri giving "broader" and "narrower" relations for their terms. It has been one of our working hypotheses that there is an essential equivalence of systems whether of a hierarchical or thesaurus type, as long as they are used to cover the same subject areas with comparable degrees of detail. The possibility of establishing conversion mappings from one to the other is the factual evidence supporting such an assumption. Beyond this essential equivalence, the hierarchical systems present one advantage--the ease with which correspondences can be established with other systems. This is an argument in favor of the use of hierarchical over thesaurus type arrangements. The fact that PACS, used by AIP, is hierarchical, whereas SHE, used by EI, is not, made the task of finding a conversion from PACS to SHE much easier than that of finding the inverse conversion from SHE to PACS. Another complicating factor, which made the latter virtually impossible, will be discussed next.

Structure of the Classification and Indexing System

As we have already pointed out, whether the classification or indexing systems to be converted are hierarchical or of the thesaurus type is a matter of relatively minor concern given their equivalence; more important is the question of whether the systems are used in a fixed or a coordinated mode. Indeed, if the subject headings are susceptible to coordination, the actual number of terms available to a given document is indeterminate; they may be any of a number of combinations, which may well be an astronomically large number. The AIP system poses no problems, since the terms that can be assigned to a document are only the nearly 2000 unambiguously coded subject headings of PACS; the situation with the EI system is not that simple.

The entries of the SHE system are noncoded units composed of a mandatory HEADING and an optional Subheading, which may be chosen for the most part from a fixed set of combinations listed in SHE. However, in quite a few instances, the combinations are left to the discretion of the indexer, so that the set of assignable terms is indeterminate in number. The situation is not as bad as with the fully correlated portions of the two systems, so that an adequate fixed set of possible SHE entries can be chosen to map PACS into it; but it is bad enough to preclude mapping of SHE entries into PACS, since the set on which the mapping matrix ought to operate is an uncoded, open-ended set. The descriptors given by Ei to a given document include, besides the HEADINGS and Subheadings mentioned above, a set of CAL code numbers. This set would not pose any major problem for the mapping in either direction, because they are almost uniquely determined from the assigned HEADING-Subheading combinations.

The results of our experiment seem to confirm that there is no basic difference between the hierarchical and controlled vocabulary type of system. Evaluations of the experiments, which we will discuss later, indicate that the modes of classification and indexing, traditionally distinguished from each other, are related more to the way the schemes are used rather than to whether they are in a hierarchical arrangement. Lower posting densities -- between two and three entries assigned per document, on the average -- seems to conform more to the classification mode, where the broad outlines of the significance of the document are depicted. Higher posting densities seem to conform to the indexing modality; indexing tends to make an inventory of particular pieces of information and usually results in the assignment of more entries than classification does. It is the remarkable closeness of the AIP and Ei posting densities (between 2 and 2.5 per document) that seems to have assured such good results for the AIP-Ei conversion experiment.

After the different parameters relevant to the conversion possibilities of the systems were assessed along the lines outlined in the preceding section, it was decided to attempt as much machine-aided conversion of the PACS indexing into the Ei indexing as possible. It was decided that the inverse operation would be very difficult, given the present state of the art, and that for the transfer of Ei material to AIP it would be more practical to supplement the required PACS indexing manually, as indexing parallel to that done for Ei. It was felt that the training of the Ei staff and other logistical problems could be solved in much the same way as had already been for the transfer of AIP material to the NSA-INIS data base, which is an ongoing, successful operation. A number of cost-oriented arguments also influenced the decision making process. It was felt that the cost incurred in the training of Ei indexers in the use of PACS would not be major, since PACS is a scheme that has been designed primarily for easy assimilation and used by the inexperienced indexers, in particular, for author indexing. On the other hand, the SHE system is quite complicated and involved, requiring trained and experienced personnel for its use and application, so that any investments in design and implementation of machine-aided conversion and in the preparation of special aid-to-the-indexer documents and tools--which would help the indexer supplement the PACS indexing with the Ei required information--were wise investments of time and effort. Furthermore, since the SHE assigned headings were not susceptible to coding as such, entering the Ei indexing information in a conventional fashion required a substantial additional burden of keyboarding and proof-reading effort. However, since the PACS-Ei mapping was planned for a subset of the possible SHE entries which was susceptible to coding, and which could be mechanically inserted from a one-time keyboarded and proof-read mapping table, the chosen route, with as much mechanical conversion as possible, was also fully justified on economic grounds.

AIP-Ei Transfer System

The final design of the conversion system was influenced by the choice of the supplier, rather than the receiver, for the entry of all supplemental and additional indexing information. This was decided on the grounds that availability of hard copy for document analysis was important; needed indexing information could not always be secured from document surrogates after transfer. In accordance with our working hypothesis, which states the equivalence between hierarchical and thesaurus type of schemes, it was decided that the mapping matrix would connect a PACS code, which is in unambiguous correspondence with one and only one subject heading, and a SHE subject heading unit, which is a combination of SHE HEADING, an optional Subheading, and CAL codes. Thus, every PACS code would have a mapping image in SHE; the correspondence would be nearly one-to-one for the area of commonality between the AIP and Ei subject coverage and many-to-one for that of interest mostly to physicists. For the areas of major interest only to engineers, which were naturally lacking detail in PACS, the detail would be added as further levels to the hierarchy. This additional detail would form what was called a "PACS Supplement." Each of the new entries in the PACS Supplement would be coded in the same fashion as each of the regular PACS headings, and would be subject to the same mapping procedures by means of a mapping matrix. The procedure thus established would map a PACS scheme supplemented with the required engineering detail into a fixed subset of possible SHE entries. In order to open up this fixed subset to some degree (to imitate as much as possible Ei indexing practices and to minimize the listing of possible SHE entries), it was decided to add "Footnotes to PACS" for certain groups of PACS headings. These were lists of terms corresponding to SHE Subheadings that could be crossed, according to the indexer's choice, with the headings they referred to.

The PACS coding system uses five characters to accommodate four levels of hierarchy, the sixth character being used for checking purposes. The introduction of the PACS Supplement required the extension of the scheme to a fifth level, and thus, the addition of a new extra character in the format of the PACS codes. The PACS Footnotes are keyed to each of the PACS chapters, which are determined by the first two characters of a regular PACS code, and an extra character referring to the particular footnote. An extended PACS code could have, for example, an additional character, or a field separator and an additional character, or any combination thereof, over the six characters of a regular PACS code. I.e., we had the following possibilities:

1234A	(regular PACS codes, without check character)
1234A/N	(PACS code with PACS Footnote)
1234AS	(PACS Supplement Code)
1234AS/N	(PACS Supplement with PACS Footnote)

In addition, a new flag indicating selection for transfer to the Ei data base had to be added to the regular data elements of a bibliographic item.

The indexing forms as well as the keyboarding instructions were modified to accept the extended PACS codes. It was decided to add, to the programs that accept input at the Data Point stage, a module that would convert the extended PACS codes into regular PACS codes and insert them into the regular fields that carry the PACS indexing information. At the same time, the extended PACS codes would be copied into newly created fields that would be subject to the mapping matrix at the time of conversion of the tape into Ei format. Operation of the input module was triggered by the existence of a non-null Ei selection flag. The system was designed to minimize disruption of existing programs and procedures and to reduce added keyboarding effort to a minimum. A logical flow chart of the input module is given in Appendix A.

The conversion of extended PACS orders to Ei indexing is effected by a module added to the programs that reformat the SPIN tapes to Ei format. The module is driven by a mapping table that maps PACS codes or PACS Supplement codes into SHE HEADING-Subheading-CAL Code combinations, the correspondence being one-to-one most of the time, sometimes one-to-many. When PACS Footnotes are present, an additional mapping table establishes a correspondence with SHE Subheadings, which are inserted in the HEADING-CAL Code combination determined by the remainder of the code. The program also eliminates duplicate entries after the mapping of all the extended PACS codes assigned to a given document is completed. Furthermore, it uses an algorithm to order the entries in importance, assuming that a similar ordering was provided by the indexer for the extended PACS codes. The most important heading determines which SHE headings go in Ei fields 12 and 13 as principal headings, and which will go to Ei field 65 as cross-references; the fields are described in detail on pages 34-35 of this report. The algorithm has some decision points for the cases when some HEADINGS appear after the conversion with different Sub-headings. A logical flow chart for the conversion module is given in Appendix B; the following is a hypothetical constructed example to illustrate the effect of the conversion program on the extended PACS indexing of a paper. Suppose that the following set of extended PACS codes has been assigned, in the following order, to a given paper:

42.78.D
42.80.G/2B
42.75.FB
47.75.FE

The programs would first insert the following regular PACS codes into their customary fields: 42.78.D, 42.80.G, 42.75.F (corresponding, respectively, to "Optical System Design", "Prisms", and "Colorimetry"). They would then convert to the extended PACS codes with the use of the mapping tables of Appendix C:

OPTICAL INSTRUMENTS--Resolving Power	741,941
OPTICAL INSTRUMENTS--Accessories	741
COLOR--Matching	741
COLORIMETRY	741

to finally assign "OPTICAL INSTRUMENTS" to Ei field 12, "Resolving Power" to field 13 and "COLOR-Matching" and "COLORIMETRY" to field 65; and "741, 941" as CAL codes.

A major effort in the implementation of the AIP-Ei conversion system was the construction of the mapping tables that drive the conversion module. This effort was concurrent with that of preparing the PACS Supplement and PACS Footnotes, since their raison d'etre is to correct missing correspondences. Appendix C gives a listing of the Mapping Table, complete for all of PACS and PACS Supplement, except for Sect. 43., Acoustics. (For best results, acoustics should be mapped from the detailed scheme used by the journal of the Acoustical Society. Unfortunately, this scheme was not amendable to coding in the PACS canonical form, and therefore, the respective mapping is given as an additional listing in a slightly different format. This situation has been corrected after recent agreements with the Acoustical Society of America, which will enable us to treat this section of the Mapping Table uniformly with the rest).

The preliminary evaluations of the system show the soundness of the approach and the overall correctness of the Mapping Tables. However, the present Mapping Tables should be seen as first approximations, susceptible to improvements and refinements that can only be discovered and implemented as part of an ongoing, operational exchange program. The continuous monitoring of the exchange material is an integral part of any exchange program in its early phases. It will undoubtedly contribute to uncovering deficiencies, mistakes, and oversights in the Mapping Tables. Furthermore, through our collaborative efforts to implement the Mapping Tables, it has been recognized by both EI and AIP that many agreements could be worked out in the future to reconcile our respective schemes, SHE and PACS, and bring them into closer correspondence to facilitate the construction and operation of the Mapping Tables. Many difficulties in the mapping process are artifacts, and do not relate to substantive differences in the subject matters. However, meaningful agreements for reconciliation of the schemes can only be worked out within the framework of an ongoing exchange program. Documents were designed which will be used by the indexers to enter into the bibliographic records the PACS as well as the PACS Supplement and the PACS Footnotes information. The assumption that the additions needed are not substantial was confirmed in the process. The indexers will be able to cope with the new material essentially without any training and approach the added material in a uniform way with the rest of PACS. A sample of the prepared documents for Sect.42., Optics, is given in Appendix D. The general philosophy in preparing the document has been to provide the indexer with as much guidance as possible, keeping him unaware of the intricacies of the SHE system. No action is necessary on his part except when some additional detail may have to be entered; these occasional instances are clear when indicated as calls to the PACS Supplement. On the other hand, a footnote type of call reminds the indexer of the possibility of choosing from a set of SHE subheadings and leads him to the corresponding footnote.

Evaluation of Results

In order to test and evaluate the feasibility of the system proposed for the transfer of indexing information, a simulated run of the algorithm for conversion was made for a number of different issues of journals which fell within different subject areas of interest to the exhange program. The results of the trials for each of the chosen areas were remarkably similar and consistently encouraging. The test procedure compared the results of the application of the conversion procedure with indexing done independently by Ei. The matching evaluation was scored according to two criteria:

a). Strict; absolute coincidence of terms.

b). Broad; close coincidence which may be counted as a satisfactory match for all practical purposes.

Appendix E discusses one of these evaluations, conducted according to the two criteria mentioned above. Using practical criterion b), after conversion half of the papers had indexing totally identical to Ei, i.e., coincidence with main headings, cross-references and CAL codes. Seventy percent of the papers coincided at the main headings, which are the most important index element for Ei; 87% had one or more coincidences at the subject headings, and 90% had one or more coincidences at the CAL codes. These results, taken from an evaluation in the area of Optics, are completely typical for the remaining areas tested. They are very encouraging and improvements to be expected from further adjustments to the system will bring the figures well within the margin of uncertainty to be expected from the indexing done by two independent, qualified teams using the same indexing system. The evaluation by AIP of the PACS indexing provided by EI is of the latter type. In this trial 86% of the papers were considered by AIP indexing staff as acceptably classified in that there was agreement with more than half of the terms selected down to the fourth level of the hierarchical classification, with 63% showing total agreement. For the AIP to Ei exchange experiment, a further test conducted with an actual computer run using the programs described above and the Mapping Table of Appendix D showed that 72% of the converted assigned headings were acceptable to the editorial division of EI; for 15% of the items an assignment of the main heading can be derived from the indexing shown in the various fields after conversion, and the remaining 13% of the records would require further refinements in the indexing Mapping Tables. These results were considered truly remarkable in view of the differences between the indexing vocabularies presently used by EI and AIP.

SPECIAL CHARACTERS

Special characters are characters which do not appear on a standard computer print chain with upper and lower case alphabets. Special characters include scientific symbols, foreign alphabets, and any standard characters with diacritical marks over, above, or through them. Since these characters are not on computer print chains, they are coded during the keyboarding operation, and are usually spelled out on distribution tapes; i.e., AIP codes the Greek α at input as @ga and the Greek Σ as @gS; these appear on AIP distribution tapes as "alpha" and "Sigma" respectively. A preliminary study made it clear that although the same symbols were sometimes used by both AIP and EI, they were frequently given different names on the output tapes. For example, $\sim$ is "approximately" at AIP and "similar" at EI; $\geq$ is "greater-than-or-equal" at AIP, and "greater than equivalent to" at EI.

AIP publishes literature which contains a great deal of mathematics, and also prints authors' names and addresses with diacritical marks. This requires a character set which is larger than that used by most of the secondary services in the United States. A comparative study was undertaken of the special characters used by AIP, EI, and CAS/BIOSIS. (The BIOSIS character set is completely contained within the CAS set, except for the male and female symbols). Table I gives the three-way comparison. The Greek upper and lower case characters have been omitted from the table, because all four services utilize the complete Greek alphabet. Most of the diacritical marks are unique to the AIP data base.

The table gives descriptions and codes for the special characters. Symbols are listed in the far left column. The codes for the AIP character set are the AIP input codes; those characters appearing on standard computer print chains are assigned standard EBCDIC hex codes. For AIP to EI exchange, EI special characters have plus codes; characters not presently used by EI have been given plus codes starting with +600. For EI to AIP exchange, all special characters (with the exception of superscript and subscript) are bracketed by $ signs; for example, word (space) $less than$ (space) word. A space appears before the first $ sign and after the second. The superscript is preceded by two asterisks, for example, 10^{21}=10**2**1. Each subscript is preceded by two slashes, for example, 10_{21}=10//2//1.

Table I. Special Characters: Comparative Study

Symbol	AIP		CAS		EI	
	Description	Code	Description	Code	Description	Code
&	ampersand	@xA	ampersand	F300	ampersand	X'50'
∠	angle	@mu	angle	9000	angle	+600
Å	A-circle	A@;0	angstrom unit	B800	A-circle	+635
𝒜	A-script	@MA	script A	4900	--------	-----
'	apostrophe	X'7D'	apostrophe	C400	apostrophe	X'7D'
≐	--------	-----	approaches	8200	--------	-----
~	approximately	@ma	approximates	DA00	similar	+115
≈	approximately-equal	@mW	approximately equal	AE00	approximately equals	+26
≅	approximately-equal	@mA	-------------	----	congruent	+25
≳	approximately-greater-than	@mE	greater than or equivalent	8900	approximately-greater-than	+601
≲	approximately-less-than	@me	less than or equivalent	8800	approximately-less-than	+602
↓	arrow-down	@mt	down arrow	CE00	arrow down	+603
←	arrow-left	@mG	reverse arrow	CD00	implied by	+500
→	arrow-right	@mg	forward arrow	CC00	yields	+57
⇄	arrow-right-left	@mh	double arrow	C900	reversible location	+39
↑	arrow-up	@mT	up arrow	CF00	arrow-up	+604
*	asterisk	X'5C'	asterisk	F500	asterisk	X'5C'
@	at	@xa	rate (at)	F200	at sign	X'7C'
↔	bold-arrow-left-right	@my	tautomer	B500	bold-arrow-left-right	+605
•	bullet	@xB	bullet	9300	--------	-----
𝒞	C-script	@MC	script C	2E00	--------	-----
¢	cent-sign	@xc	cent	F600	cent	+27
·	center-dot	@mH	center dot	C300	multiplied by	+19
◐	-------	-----	circle left solid	9200	--------	-----
○	circle-open	@mm	open circle	9400	--------	-----
●	circle-solid	@xo	fat dot	9600	--------	-----
◑	-------	-----	circle right solid	9100	--------	-----
}	closing-brace	X'D0' or @mb	right brace	E700	right brace	+56

Special Characters: Comparative Study

	AIP		CAS		EI	
Symbol	Description	Code	Description	Code	Description	Code
○	------	----	close-up	EC00	------	----
:	colon	X'7A'	colon (double bond)	FB00	colon	X'7A'
,	comma	X'6B'	comma	FC00	comma	X'6B'
⊃	contains	@xh	contains	8600	contains	+606
∮	contour-integral	@mr	bounded integral	DF00	contour-integral	+607
©	copyright-sign	@xC	-------	----	-------	-----
▬	-------	----	cut mark	C800	-------	-----
□	D'Alembertian	@mM	box	9B00	D'Alembertian	+608
†	dagger	X'8F'	dagger	EE00	dagger	+609
°	degree	@mD	degree	F000	degree	+20
∇	del	@mc	del (operator)	C100	del	+121
◊	-------	----	diamond vertical open	8C00	-------	-----
♦	diamond-solid	@xd	diamond vertical solid	8B00	-------	-----
⊗	direct-product	@mo	-------	----	direct-product	+610
⊕	direct-sum	@mO	symmetry	A700	direct-sum	+611
÷	divided-by	@xy or @my	division	D300	divided by	+34
⇏	-------	----	does not result in	7000	-------	-----
$	dollar-sign	X'5B'	dollar	F700	dollar sign	X'5B'
=	-------	----	double bond	9E00	-------	-----
‡	double-dagger	@xD	double dagger	AF00	double-dagger	+612
⇌	-------	----	double half arrows	7700	-------	-----
ǂ	-------	----	double plus	9A00	-------	-----
″	double-prime	@m′	double prime	F900	double prime	+41
ℰ	E-script	@ME	script E	4A00	-------	-----
—	em-dash	X'6D'	long dash	C000	em dash	+13
–	en-dash	@xn	dash	D000	en-dash	+613
=	equal	X'7E'	equal	DE00	equal	+32

Special Characters: Comparative Study

	AIP		CAS		EI	
Symbol	Description	Code	Description	Code	Description	Code
≡	equivalent	@md	identity	DC00	equivalent	+614
!	exclamation-point	X'5A' or @mz or @xz	exclamation mark	FD00	exclamation point	X'5A'
ℱ	F-script	@MF	script F	2B00	-------	-----
♀	-------	----	female symbol	A400	-------	-----
ς	-------	----	final sigma (variant)	4240	-------	-----
	fixed space	X'7F'	blank (space)	0100	space bar	X'40'
↷	-------	----	forward curved arrow	8700	-------	-----
𝒢	G-script	@MG	script G	4B00	-------	-----
>	greater-than	@g$ or @m$	greater than	E500	greater than	+22
≥	greater-than-or-equal	@mS	greater-than-equal	E300	greater than equivalent to	+24
ℏ	h-dash-bar	@mC	plank's constant/2π	A300	h-dash-bar	+615
ℋ	H-script	@MH	script H	2C00	-------	-----
–	hyphen	X'5F'	hyphen	7D00	hyphen	X'5F'
∞	infinity	@mi	infinity	D900	infinity	+28
∫	integral-large	@mF	-------	----	-------	-----
∫	integral-small	@mf	integral	D700	integral	+17
▼	inverted-triangle-solid	@xT	triangle-down solid	8000	-------	-----
∈	is-an-element-of	@xe	member of	8500	is-an-element-of	+617
⊂	is contained in	@xH	contained in	8700	is-contained-in	+618
ϰ	-------	----	kappa (variant)	3A40	-------	-----
ℓ	l-script	@Ml	script l	2D00	l-script	+619
⟨	left-angle-bracket	@mv	left broken bracket	8900	left-angle-bracket	+620
[	left-bracket	X'AD'	left bracket	EA00	left bracket	+8
“	-------	----	left double quotation mark	A000	left double quote	+1
(	left-parens	X'4D'	left parenthesis	E800	left parens	X'4D'
<	less-than	X'4C' or @g% or @m%	less than	E400	less than	+21

Special Characters: Comparative Study

	AIP		CAS		Ei	
Symbol	Description	Code	Description	Code	Description	Code
⩽	less-than-or-equal	@ms	less than-equal	E200	less than equivalent to	+23
♂	-------	----	male symbol	A500	-------	----
-	minus	X'60'	dash (minus)	D000	minus	+31
∓	minus-or-plus	@m7	minus-plus	9800	minus-or-plus	+621
♀	-------	----	neuter symbol	A600	-------	----
≠	not-equal	@mR	not equal	DD00	does not equal	+16
#	number-sign	@xN	pound	F400	number sign	X'7B'
½	-------	----	-------	----	one half	+504
¼	-------	----	-------	----	one quarter	+503
{	opening-brace	@mB or X'C0'	left brace	E600	left brace	+55
‾	over-bar	@mK	-------	----	-------	----
℘	P-script	@MP	script P	4C00	-------	----
¶	paragraph	@xP	paragraph	7E00	-------	----
//	parallel	@mN	double vertical	BA00	parellel	+502
∂	partial	@mL	delta (variant)	3440	partial	+622
%	per-cent	X'B7'	percent	F100	percent sign	X'B7'
. .	period	X'4B'	period	CA00	period	X'4B'
‰	-------	----	per mill	A200	-------	----
⊥	perpendicular	@mn	perpendicular	CB00	perpendicular	+623
ϕ	-------	----	phi (variant)	4540	-------	----
ϖ	-------	----	pi (variant)	4040	-------	----
+	plus-sign	X'4E'	plus	D200	plus	+30
±	plus-or-minus	@m	plus minus	D100	plus or minus	+35
£	pound	@x4	pound sterling	C700	pound	+624
′	prime	@m'	prime (single quote)	F800	prime	+40

Special Characters: Comparative Study

	AIP		CAS		EI	
Symbol	Description	Code	Description	Code	Description	Code
Π	product	@mX	product	7500	product	+625
∝	proportional	@ml	varies	D800	varies directly as	+4
?	question-mark	X'6F'	question mark	FE00	question mark	X'6F'
"	quote	X'7F'	-------	----	-------	----
®	-------	----	registered trademark	EF00	-------	----
↶	-------	----	reverse curved arrow	B600	-------	----
ℛ	R-script	@MR	script R	4000	-------	----
⟩	right-angle-bracket	@mv	right broken bracket	B800	right-angle-bracket	+626
]	right-bracket	X'7D'	right bracket	EB00	right bracket	+9
”	-------	----	right double quotation mark	A100	right double quote	+2
)	right-parens	X'5D'	right parenthesis	E900	right parens	X'5D'
√	root	@mZ	square root	D400	root	+627
§	section	@xS	section	7F00	section	+628
;	semicolon	X'5E'	semi-colon	FA00	semicolon	X'5E'
≃	-------	----	similar or equal	B400	-------	----
—	-------	----	single bond	9F00	-------	----
′	single-quote	X'8D'	prime (single quote)	F800	prime	+40
/	slash	X'61'	slash	E100	slash	X'61'
⌲	-------	----	standard taper	8100	-------	----
■	square-solid	@xs	-------	----	-------	----
☆	-------	----	star	8A00	-------	----
—	-------	----	strike through	AB00	-------	----
Σ	summation-large	@mJ	-------	----	-------	----
Σ	summation-small	@mj	summation	7600	summation	+629
⊙	sun	@xO	mass of sun	9000	sun	+630
∴	-------	----	therefore	8300	-------	----
ϑ	theta-variant	@gc	theta (variant)	3840	-------	----

Special Characters: Comparative Study

	AIP		CAS		Ei	
Symbol	Description	Code	Description	Code	Description	Code
	thin-space	X'AC'	-------	----	thin-space	+631
×	times	@g or @m	times	D500	multiplied by	+33
∇	-------	----	triangle down open	8E00	-------	----
▼	-------	----	triangle down solid	8D00	-------	----
△	triangle-open	@mp	triangle-up open	9000	-------	----
▲	triangle-solid	@xt	triangle-up solid	8F00	-------	----
⋮	-------	----	triple bond	DB00	-------	----
≡	-------	----	triple bond	7300	-------	----
‴	triple-prime	@mw	-------	----	triple prime	+42
╳	undefined character	@xX	undefined character	FF00	undefined character	+634
∪	-------	----	union	8400	-------	----
_	-------	----	underscore	BC00	-------	----
|	vertical-bar	@mU or @mK	vertical bar	C200	vertical	+501
≫	very-much-greater-than	@mQ	much greater than	A800	very-much-greater-than	+632
≪	very-much-less-than	@mq	much less than	A900	very-much-less-than	+633
‾	-------	----	vinculum	BE00	-------	----
\	-------	----	virgule	E000	-------	----
	word space	X'40'	-------	----	word space	+0
¥	-------	----	yen	C600	-------	----
´	-acute-accent	@;a	acute	7A00	-------	----
→	-arrow-right	@;v	vector	7100	-------	----
-	-bar	@;m	-------	----	-------	----
⩮	-bar-and-dieresis	@;N	-------	----	-------	----
∸	-bar-and-dot	@;M	-------	----	-------	----
—	-bar-through	@;B	-------	----	-------	----

Special Characters: Comparative Study

	AIP		CAS		EI	
Symbol	Description	Code	Description	Code	Description	Code
˘	-breve	@;b	------	----	------	----
ˇ	-caron	@;w	caron	7B00	------	----
¸	-cedilla	@;c	cedilla	7800	------	----
˚	-circle	@;0	------	----	------	----
^	-circumflex	@;x	circumflex accent	AA00	------	----
¯	-dash-bar	@;s	------	----	------	----
¨	-dieresis	@;u	overhead double dot	B200	------	----
˙	-dot	@;D	overhead dot	B300	------	----
.	-dot-below	@;d	------	----	------	----
=	------	----	double bar overhead	7C00	------	----
˝	-double-acute	@;U	------	----	------	----
`	-grave-accent	@;g	grave accent	7900	------	----
ˀ	-hook	@;h	------	----	------	----
⁀	-inverted breve	@;T	------	----	------	----
~	-tilde	@;t	tilde	BF00	------	----

DATA ELEMENTS AND DATA ELEMENT CONTENT

Most abstracting and indexing services use the same basic minimum set of data elements for journal articles:

Bibliographic citation (journal, volume, page number, year)
Title of article
Author (s) name (s)
Author (s) location (s)
Abstract
Indexing information

However, there are substantial differences among the a and I services in the treatment of the content of the data elements, based on the usage made by the service. For example, EI puts an article title in all upper-case letters; AIP capitalizes only the first letter of the first word in the title, proper names and symbols; a special program is necessary to interchange the two procedures. Another example is the different methods of handling authors' names. AIP uses a highly structured field in which each author's name is broken into tagged subfields for first name and initials, surname, and post-particles such as "Junior"; no limit is set, because the entries are used to computer-photocompose authors' names for articles in AIP primary journals and author indexes, which form the permanent archive for physics. Since EI is not responsible for preserving the primary literature as an archive, they permit truncation after the first sixteen authors' names on an article; the author name is inverted in the file, with the surname given first, followed by the first name(s) and then the post-particle, separated by spaces and commas.

The data elements chosen for the interchange between AIP and EI are described by their assigned field ID number as follows:

Field 10	This is an internally assigned accession number, character length 12.
Field 11	This contains the title of the document. Original title is all upper case. If not in English, it is as follows: [Orig. Title (all upper case) (.)] [$left bracket$] [English title (upper and lower case) (.)] [$right bracket$] Special characters are present.
Field 12	Contains main subject heading, taken from the EI controlled vocabulary SHE (Subject Headings for Engineering). This is all upper case with no special characters. Maximum length 50 characters. There is only one main heading for each document and must always be present.
Field 13	Contains subheading, also selected from SHE; this field may or may not be present. Maximum characters 50; again only one subheading allowed per document, upper and lower case, no special characters present.
Field 20	Contains authors. No special characters allowed. Maximum of 16 authors present. Author name is inverted and is as follows: Last name, (space) first name, (space) post particle X'5F' next author. X'5F' is the subfield initiator.
Field 30	Contains the monthly abstract number, internally assigned, 6 characters long.
Field 31	Contains the citation. No subfields; data is a single string of characters consisting of the abbreviated journal name as it appears in PIE (Publications Indexed for Engineering) and volume, issue, date and page information.
Field 32	Contains item number, for CAL code. 6 characters
Field 33	Contains CODEN of the publication indicated in field 31. 6 characters.
Field 34	Null data element reserved for ISSN Designation.
Field 40	Contains author affiliation, free form data given for 1st author only. No special characters, some abbreviation.
Field 50	Contains the abstract of the item. Must always be present;

is given in one paragraph only, upper and lower case, special characters are present, and a period and space at the end of each sentence. Last sentence contains a number of references. If the article is in a language other than English, and an English abstract is given, the last sentence contains the number of references, and the last sentence but one the language; e.g., 'In German with English abstract'. If an English abstract is not given, the last sentence would be, for example, 'In German'.

Field 60 — Contains CAL codes. A maximum of 6 codes are allowed. Each code is separated by the subfield X'5F'. These CAL codes provide additional search capability, and correspond to additional levels of indexing. There is at least one CAL code per item.

Field 65 — Contains cross-reference terms. As many as five such terms are allowed. This field may or may not be present. Each cross-reference consists of a main heading in all capitals which may be followed by \$-\$ and a subheading in upper and lower case. When there is no subheading, the next cross-reference, if any, begins after the subfield terminator X'5F'. These cross-reference terms provide secondary indexing information for the item, and are chosen from SHE, the classification scheme for engineering.

Field 80 — Contains PACS indexing, i.e., indexing done using the AIP classification scheme. The + sign in the AIP classification codes is given as a '/', and the last character in the code is an upper case alphabetic charcter instead of a lower case one. The quality of indexing as checked by AIP staff was found to be satisfactory.

In addition to the study of data elements required for interchange between AIP and Ei, data element usage was also compared at meetings held by AIP, Ei, BIOSIS and CAS.

A log of the data elements used by AIP (8), Ei (9), and CAS (10) is given in Table II. Table III contains a detailed analysis of the data element content requirements of each service.

Table II. Data Element Identification Log

Data Element Name	ID		
	AIP* SPIN	EI COMPENDEX ANSI	CAS CA CONDENSATES SDF FORMAT
1. Citation Data			
1. Abbreviated Journal Name	*JOU #CAB	31	005D 01
2. CODEN	*JOU #COD	33	0055 01
3. Journal Volume Number	*VOL #VNO	31	005F 01
4. Journal Issue Number	*VOL #NUM	31	0060 01
5. Journal Issue Date	*DAT #YEA #MOD	31	005E 01
6. Journal parts, series or other information	*STR	31	005F 01 0060 01
7. Article Page Number	*PAG #PNO #PNL #SEQ	31	0061 01
8. Original Language of Journal Article	--	50 (listed as part of abstract)	0063 02
9. Original Language Code for Journal Article	--	--	0063 01
2. Author Data			
1. Personal Author Name	*AUT #AGR ¢AUI %AUF %AUS %AUP	20	0059 01-0A

Data Element Name	ID		
	AIP* SPIN	EI COMPENDEX ANSI	CAS CA CONDENSATES SDF FORMAT
2. Corporate Author Name	*AUT #AGR ¢AUC	20	0059 0B-14
3. Author Location:	*LOC #LGR ¢LOI	40	--
1. Division of Organization	*LOC	40	005A 01
2. Name of Organization	*LOC	40	005A 02
3. City of Location	*LOC	40	005A 03
4. Country of Location	*LOC	40	005A 04
3. Article Title	*TIT	11	005B 01
4. Article Abstract	*ABP	50	--
5. Keyword. Phrases	*KWI	80	0077 01
6. Document Analysis (Indexing)	*DAN #DTP #DYR #DKD #DNI #DNJ	12, 13, 60, 65	0067 01, 031B 00

*The subfields are indicated by tags beginning with #, ¢ and %. These are grouped under the main field.

Table III. Data Element Descriptions

1.1-1 Abbreviated Journal Name

A. AIP Standard SPIN format:

*JOU	The field tagged by *JOU contains two subfields.
#CAB	One of these two subfields tagged by #CAB is a variable length field and contains the abbreviated journal title. The abbreviations correspond to those recommended by International Organization for Standardization (ISO).

B. EI COMPENDEX ANSI format:

31	There are no subfields within the field tagged by 31. Data is a single string starting with the abbreviated journal name as it appears in Publications Indexed for Engineering (PIE). There are no periods and commas in the abbreviated journal title. Maximum size of this field is 200 characters.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

005D 01	This data element uniquely identifies the abbreviated journal name, according to The International Organization for Standardization (ISO). The storage length in bytes is minimum 2 and maximum 180. The storage mode is ASCII-8.

1.2-1 CODEN

A. AIP Standard SPIN format:

*JOU #COD	*JOU is subdivided into two subfields, the first one tagged by #COD contains CODEN representing the title of journal as established by ASTM. The field is of fixed length and contains five characters. It does not contain a sixth check digit.

B. EI COMPENDEX ANSI format:

33	This field contains the CODEN given as the five characters with a sixth check digit. This check digit is calculated and reported as an error in system processing.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

0055 01	This data element contains the CODEN of the title of the journal from which a document is obtained. This field has a fixed storage length equal to six characters, the first five characters represent the CODEN and the sixth is a check digit.

1.3-1 Journal Volume Number

A. AIP Standard SPIN format:

*VOL #VNO	The field *VOL is subdivided into two fields tagged by #VNO and #NUM. #VNO is an optional variable length field and contains journal volume number.

B. EI COMPENDEX ANSI format:

31	The journal volume number is part of a single string of data in field 31. Data is given in a specific format for each journal covered by EI. Field 31 is a variable length field with a maximum length of 200 bytes.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

005F 01	Field 005F 01 identifies the journal volume number. Storage length in bytes is minimum 1 and maximum 20. Storage mode is ASCII-8.

1.4-1 Journal Issue Number

A. AIP Standard SPIN format:

*VOL #NUM	The journal issue number is contained in field #NUM, which is one of the two subfields of *VOL. This is an optional variable length field.

B. EI COMPENDEX ANSI format:

31	Journal issue number is part of free form collection of citation data contained in field 31. There are specific formats for journal issue numbers of each of the journals covered by EI. Maximum length of field is 200 bytes.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

0060 01	This data element identified the journal issue number of the document. For some journals, especially numbered publishers series, e.g., Advances in Chemistry Series, this identifies the distinctive title of the volume. The issue number is identified by field 005F 01. The minimum storage length in bytes is 1 and maximum 150. Storage mode is ASCII-8.

1.5-1 Journal Issue Date

A. AIP Standard SPIN format:

*DAT #YEA #MOD	*DAT contains the journal issue date. It is divided into two subfields tagged by #YEA and #MOD. The first one contains the year of publication, the second month and day. These two subfields are of fixed length and are always present.

B. EI COMPENDEX ANSI format:

31	Journal issue date is contained in field 31 as part of citation data. There are specific formats for journals covered by EI. Maximum length of field 31 is 200 bytes.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

005E 01	Identifies the publication date of document. Data field format DDMMYY, where DD=day of month, right justified with leading zero. MM=month of year, right justified with leading zero. YY=last two digits of year. If day or month information is not available, zeros are input in the corresponding position. Storage length in bytes 6, storage mode ASCII-8.

1.6-1 Journal Parts, Series or Other Information

A. AIP Standard SPIN format:

*STR	This is an optional variable length field and contains the journal series and parts information. This field is not subdivided.

B. EI COMPENDEX ANSI format:

31	Journal parts and series information or any other such information is part of data in field 31. There are specific formats for journals covered by EI. Maximum length of field 31 is 200 bytes.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

005F 01 0060 01	The data element identified by 005F 01 contains the journal series information in addition to journal volume number. Similarly, the data element identified by 0060 01 contains report, and/or part number in addition to the journal issue number. Storage length in bytes in field 005F 01 is maximum of 20 and in field 0060 01 150. Storage mode in both fields is ASCII-8.

1.7-1 Article Page Number

A. AIP Standard SPIN format:

*PAG
#PNO
#PNL
#SEQ

The article page numbers are contained in field *PAG which is subdivided into three fields tagged by #PNO, #PNL and #SEQ. The first of the subfields #PNO is of variable length, is always present and contains the first page of article. The field tagged by #PNL is similarly of variable length, is always present and contains the last page of article. #SEQ determines the sequence of articles on same page when there is more than one article on the same page. This field is likewise of variable length and is always present.

B. EI COMPENDEX ANSI format:

31

Article page numbers are contained in field 31 as part of citation data. Field 31 has a maximum storage length of 200 bytes. The page numbers are indicated by p followed by space, first page hyphen and last page.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

0061 01

This data element identifies the inclusive pagination of journal articles. Information other than page numbers may be contained in this data element. Articles which are continued have all the additional citation information necessary to identify the parts included in this data element. e.g., 9-11; (17), 24-6, 28-9; 1967 13 (1), 9-14.
Maximum storage length in bytes is 80, minimum 2.
Storage mode is ASCII-8.

1.8-1 Original Language of Journal Article

A. AIP Standard SPIN format:

--	There is no data element in the AIP data base which identifies the original language of the journal articles.

B. EI COMPENDEX ANSI format:

50	The original language of the document, if it is other than English is contained in this data element and forms part of the abstract of the article. Field 50 identifies the abstract of the article. The original language is given in the last but one sentence of the abstract as follows: "In" followed by space followed by an abbreviation for original language, e.g. in Ge.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

0063 02	This data element identifies the name or abbreviation of the original language (s) of a journal article. For two languages a slash (/) is used to separate them. Maximum storage length is 20 bytes, minimum 1. Storage mode is ASCII-8.

1.9-1 Original Language Code for Journal Article

A. AIP Standard SPIN format:

--	There is no data element in the AIP data base which identifies the original language of the document. Hence no data element for original language code.

B. EI COMPENDEX ANSI format:

--	There is no data element which identifies original language code in EI data base.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

0063 01	This data element contains a two letter code which identifies the original language(s) of a document. For two languages, a slash (/) sign separates them. The minimum storage length is 2 bytes, maximum 5. Storage mode is ASCII-8. This is in addition to the name of the original language.

2.1-2 Personal Author Name

A. AIP Standard SPIN format:

- *AUT
  - #AGR
    - ¢AUI
      - %AUF
      - %AUS
      - %AUP

The field tagged by *AUT contains the name(s) of author(s) of the article. This is a highly structured field. Individual authors from the same institution(s) are grouped in subfields tagged #AGR. Individual author's names are broken into three parts: a first name and/or initials, a surname, a post-particle. These are contained in subfields tagged by %AUF, %AUS and %AUP respectively. If the first name consists of initials only, the initials are separated by period space. There is no limit on the number of authors. The data elements containing author information are of variable length; special characters (diacritical marks) are allowed.

B. EI COMPENDEX ANSI format:

20

Personal author names are contained in field 20. Maximum of 16 authors are allowed. No special characters allowed in this field. The author name is inverted, the surname is given first followed by comma space, then the post particle. If the first name consists of initials only, the spaces between initials are removed.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

0059 01-0A

This data element identifies the personal name(s) of author(s) of the document. Up to 10 names are allowed. For more than 10 names, nine are identified and 'et al' is used as the last name. ID modifiers 01 through 0A in hexadecimal are used to input up to 10 names. Names are input in inverted form, the surname comma space first name and/or initials and, if applicable, indicators (post particle). Spaces are used between initials as in the AIP %AUF field. Diacritical marks are not allowed. Maximum storage length is 110 bytes and minimum 6. Storage mode is ASCII-8.

2.2-2 Corporate Author Name

A. AIP Standard SPIN format:

*AUT #AGR ¢AUC	Corporate author name is contained in subfield tagged ¢AUC. This is a variable length field. There is no limit on the number of corporate authors. Special characters (diacritics) are permitted.

B. EI COMPENDEX ANSI format:

20	Corporate author name is contained in field 20. Maximum of 16 authors allowed, no special characters are permitted.

C. CA CONDENSATES Standard Distribution Format (SDF):

0059 0B-14	This data element identifies the corporate name(s) of author(s) of journal articles. Up to 10 names may be included by using ID modifiers 0B through 14 in hexadecimal. For more than 10 names, nine names are identified and 'et al' is used for the last name. Corporate names which contain the name of an individual plus other words or initials record the surname of the individual first, followed by his other name(s) and/or initial(s), and then the other words or initials (e.g., Anderson, Clayton and Co.). No diacritical marks are allowed. Maximum storage length = 110 bytes, minimum 6; storage mode is ASCII-8.

2.3-2 Author Location

A. AIP Standard SPIN format:

*LOC #LGR ¢LOI	The field tagged by *LOC contains the name(s) of the institution(s) with which the author(s) of the journal article are affiliated. To each author group in the *AUT field there corresponds one location group in the *LOC field. Authors affiliated with two or more institutions are grouped in subfield tagged by #LGR, subfield ¢LOI then lists these institutions. A group may consist of a single institution. The author locations are input in the form supplied by the authors, no abbreviations (e.g. dept. for department) are substituted for words supplied by authors. ¢LOI is a variable length field and there is no limit on number of locations. Special characters (diacritics) are allowed.

B. EI COMPENDEX ANSI format:

40	This data element contains the affiliation of the first author. There are no special characters included in this field. Some abbreviations (e.g. Univ. for University) are used. Maximum number of characters is 200 for this field.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

--	The author location is contained in four separate data elements, containing the division of organization, name of organization, city and country of location respectively. These four data elements correspond to field *LOC in the AIP data base and to field 40 in the EI data base. No special characters are allowed.

2.3.1-2 Author Location: Division of Organization

A. AIP Standard SPIN format:

*LOC	The division of organization of the location of author, if supplied by the author, is part of a string of data, contained in field *LOC. There is no separate data element for the division of organization of the affiliation of author in the AIP data base.

B. EI COMPENDEX ANSI format:

40	The division of organization of the location of author, if supplied by the author, is part of the free form data contained in field 40. There is no separate data element in the EI data base for the division of organization of the location of author.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

005A 01	This data element identifies the specific department, laboratory, division, school, etc. of an organization where the reported work was done. If the information is not given, the address of the senior author is assumed to be the location of work. The maximum storage length is 300 bytes, minimum 1. Storage mode is ASCII-8.

2.3.2-2 Author Location: Name of Organization

A. AIP Standard SPIN format:

*LOC	The name of the author's organization where the work was done is part of data contained in data element tagged *LOC. There is no separate data element for the name of organization where the work was done in the AIP data base.

B. EI COMPENDEX ANSI format:

40	The name of the author's organization where the work was done is contained in field 40 and forms part of the string of data in that field. There is no separate data element in EI data base for name of the author's organization where the work was done.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

005A 02	This data element identifies the name of the organization, university, institute, etc., where the reported work was done. If the information is not given, the address of the senior author is assumed to be the location of work. The maximum storage length is 300 bytes, minimum 1. Storage mode is ASCII-8.

2.3.3-2 Author Location: City of Location

A. AIP Standard SPIN format:

*LOC	There is no separate data element for the city of location of the author in the AIP data base. This information is contained in field *LOC and forms part of other information regarding author location.

B. EI COMPENDEX ANSI format:

40	The information regarding the city of location of author is contained in field 40 as part of other information regarding author location. There is no separate data element in EI data base that contains this information.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

005A 03	This data element identifies the city where the reported work was done. If the information is not given for the reported work, the address of the senior author is assumed to be the location of the work. The storage length is maximum 60 bytes, minimum 1. Storage mode is ASCII-8.

2.3.4-2 Author Location: Country of Location

A. AIP Standard SPIN format:

*LOC	The country of location of the author is contained as part of other location data in field *LOC. There is no separate data element that identifies the country of location of author in the AIP data base.

B. EI COMPENDEX ANSI format:

40	The country of author location is part of the string of data contained in field 40. There is no separate data element that identifies the country of author location in EI data base.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

005A 04	This data element identifies the possession, Canadian province, USA state, or foreign country where the reported work was done. If the information is not given for the reported work, the address of the senior author is assumed to be the location of work. CAS has their own abbreviations for the country, possession, etc. Storage length is a maximum of 40 bytes, minimum of 1. Storage mode is ASCII-8.

3-3 Article Title

A. AIP Standard SPIN format:

*TIT

The article title is contained in field tagged *TIT. Titles are input in lower case letters with initial capital letter. Proper names and abbreviations are exceptions. These are input in caps or mixed upper/lower case letters. There is no period at the end of title. Foreign language titles are not translated into English, these titles are input in the original form. Special characters including diacritical marks are included. Document titles are not edited and are input in the form in which they appear in original document. *TIT is a variable length field.

B. EI COMPENDEX ANSI format:

11

The title of the document is contained in field 11. The original title is input in upper case except where abbreviations call for mixed upper/lower case. There is a period at the end of title. Foreign language titles are translated into English and the English title together with the original title is input in field 11. The format is as follows

```
[orig. title.][$LEFT BRACKET][English Title.]
[RIGHT BRACKET$]
```

The translated English title is input in upper and lower case as against the original English language titles which are always input in upper case. Special characters other than diacritical marks are included. No editing is done on original document titles. The theoretical word limit is 200 words for the title.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

005B 01	This data element identifies the edited version of the title in the original document. Foreign titles are translated into English. British spellings are changed to their American forms. English plurals are used in preference to those of Latin or Greek. Abbreviations and symbols are used in editing the original titles. Special characters are included. Maximum storage length is 300 bytes and minimum 1 byte. Storage mode is ASCII-8. Abbreviations, chemical element symbols, and chemical line formulas for compounds (e.g., EtOH for Ethanol) are expanded to the name where possible. Acronyms on official ACS abbreviations list such as DNA, RNA, etc. are exceptions to the general rule of writing out abbreviations. Complex, indeterminate chemical formulas, however, are used in titles as they appear in original document. Supplementary terms are sometimes added to titles that are misleading or indefinite.

4-4 Article Abstract

A. AIP Standard SPIN format:

*ABP

Each paragraph from the article abstract is contained in field tagged *ABP. If the article is in a foreign language, the abstracts are usually given in English. These are input together with a foreign language title (the title is not translated into English). Special characters are included, the abstract is in upper/lower case letters. *ABP is a variable length field with a maximum storage length of 3520 bytes.

B. EI COMPENDEX ANSI format:

50

The article abstract is contained in field 50. The abstract is input as one paragraph, there is no paragraphing structure in the abstract. There is a period space at end of each sentence and it is in upper/lower case letters. Special characters are included. The last sentence of the abstract may give number of references. e.g. ,

[abstract] . [16] .

If the article is in a foreign language, the original language is given in the last but one sentence of the abstract. The abstract is translated into English, e.g.,

[abstract] . [In Ge] . [16].

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

--

The article abstract is not contained in the CA CONDENSATES data base.

5-5 Keyword Phrases

A. AIP Standard SPIN format:

*KWI	Free language terms or keyword phrases are contained in fields tagged *KWI. Each field-tagged *KWI identifies one keyword phrase. The keyword phrases are used to augment the article title. There is no limit on the free language terms, although it rarely exceeds four. Special characters are included, keyword phrases are in upper/lower case letters. *KWI is a variable length field. (Not used in 1975 except for special subsets of data base).

B. EI COMPENDEX ANSI format:

80	Free language terms are contained in field 80. A maximum of 5 free language terms is allowed. Special characters are included.

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

0077 01	This data element identifies one keyword phrase. Multiple keyword phrases will occur as multiple appearances of this data element. Punctuation marks are not used. The keyword phrases are input in upper/lower case letters. Special characters are included, abbreviations and acronyms are from the authorized ACS publications list. The maximum storage length is 150 bytes. Storage mode is ASCII-8.

6-6 Document Analysis (Indexing)

A. AIP Standard SPIN format:

*DAN
#DTP
#DYR
#DKD
#DNI
#DNJ

The field tagged *DAN contains indexing information. The subfield #DTP of this field specifies the document type. It contains either a letter code x or a construction of the form x/y, where x (or y) = E for experimental, T for theoretical, R for review. There are six codes in all, specifying the document type. T, E, E/T, T/E, R, and X. The last one, X, is used for general types of documents e.g. biographies, etc. The subfield #DYR gives the year of the Physics and Astronomy Classification Scheme's publication. This is a 2 digit code. The subfield #DKD specifies the document kind; it contains a letter code x, where x = A for abstracts, B for book reviews, E for errata, L for letters, notes or short communications, M for comments and addenda, P for patents and X for unspecified documents. The subfields #DNI and #DNJ contain six character index codes assigned to the article by the authors or AIP indexers from the Physics and Astronomy Classification Scheme (PACS). There is a maximum of 5 index terms that are allowed in #DNI. The main subject heading for the article is usually listed in the first #DNI field and supplementary terms are listed in subsequent #DNI. If the document requires more than 5 indexing terms, they are listed in subfields #DNJ.

B. EI COMPENDEX ANSI format:

12, 13, 60, 65

The indexing information of the document is contained in four separate data elements 12, 13, 60 and 65. The first of these, 12, contains the Main Subject Heading which is mandatory in the EI system. A maximum of 50 characters is reserved for this field. The Main Subject Heading is selected from the Subject Headings for Engineering (SHE). Field 13 contains the subheading corresponding to the Main Subject Heading from SHE. A maximum of 50 characters is assigned to this field. The contents of field 60 are the Card-A-Lert Codes. Up to six codes may be assigned. The first Card-A-Lert Code is considered to be the most important broad subject category. EI anticipates that by 1976 there will be a direct relationship between the Main Subject Heading from SHE and the first Card-A-Lert Code, and each of the cross references with the other Card-A-Lert Codes.

The Cross Reference Terms are contained in field 65. Each Cross Reference consists of an upper case main heading, with or without a subheading. Up to 5 Cross Reference Terms may be assigned. The upper case main heading is taken from controlled vocabulary (SHE), while the subheading may be either from SHE or free form. When a subheading is present in a Cross Reference Term, the upper case main heading is followed by $ followed by a long dash followed by $ then the subheading with initial letter in caps and rest is lower case letters. e.g.,

FOUNDATIONS$—$Stresses

C. CA CONDENSATES CAS Standard Distribution Format (SDF):

0067 01, 031B 00 The indexing information of the document is contained in fields 0067 01 and 031B 00. The document is only broadly indexed under 80 subject categories (sections), on the basis of the principal subject interest of the document. The first 34 sections are published as an odd-numbered issue one week; and the remaining 46 sections are published as an even-numbered issue the following week.

The data element identified by 0067 01 contains the section within an issue of CA, where the document data is located. Specifically it includes the CA publication code, section number and subsection number. The data field format is CASSSUUU where CA = CHEMICAL ABSTRACTS publication code (CC for CA CONDENSATES); SSS = section number, right justified with leading zeros, UUU = subsection no., right justified with leading zeros. Storage length is 8 bytes. This data field is always present, storage mode is ASCII-8.

The data element identified by 031B 00 contains up to 10 CA section cross references (in addition to the section in which it actually appears). The storage length is minimum 13 and maximum 40 bytes; storage mode is ASCII-8. Byte 1 through 5 contain the number of entries, 6 through 10 the length of each entry, 11 through 13 section number (right justified with leading zeros), 14 through 16 next section number and so on up to byte 40.

FORMAT CONVERSION

It was agreed that the format for tape exchanges between AIP and Ei would be compatible with the American National Standards Institute standard for Bibliographic Information Interchange on Magnetic Tape. Ei already distributes a tape in this format and AIP anticipated no difficulty in converting to the same format.

Data is given in unblocked variable length records with a maximum record length of 9999 characters. The output tape does not contain labels of any kind. It begins with the 24-character leader for the first bibliographic entry. Each physical record has a leader, followed by directory entries, followed by data elements and sub data elements, followed by a record terminator.

<LEADER> <DIRECTORY> <DATA ELEMENTS> <RECORD TERMINATOR>

LEADER: A fixed field which occurs at the beginning of each bibliographic record and provides parameters for the processing of the record.

	BYTES
Overflow indicator will be zero because the lengths of logical and physical record are the same.	1
Record length	4
Status will be N for new records	1
Type of Record = blank	1
Bibliographic level = blank	1
Data positions = blanks	2
Indicator count = 3, gives number of characters in field tag, includes field initiator, X'5F', as the first character.	1
Delimiter count = length of field terminator, subfield terminator and record terminator in characters = 1.	1

Base address of data = base address of the first data element relative to beginning of the physical record.	5
Reserved positions = blanks	3
Entry map = 4500, 4 being the number of characters used for the record length, and 5 the number of characters used for the base address of data. These two items are used for each data element represented in the directory.	4
	24

DIRECTORY:

An index to the location of the variable data elements within a bibliographic item. The directory consists of 37 fixed length entries. Each entry corresponds to a data element and is structured as follows:

Tag	3
Length	4
Base address relative to end of directory	5
	12

Null data elements are represented in the directory entry as a string of 12 zeros.

DATA ELEMENTS:

The first data element begins immediately after the last character of the Directory. Its structure follows:

Initiator = X'5F'	1
ID	2
Data	Variable length
Terminator = X'4F'	1

SUB DATA ELEMENTS:

Structure of a sub data element within a data element

Initiator = X'5F'	1
Data	Variable length

LAST DATA ELEMENT:

The last data element within the bibliographic entry.

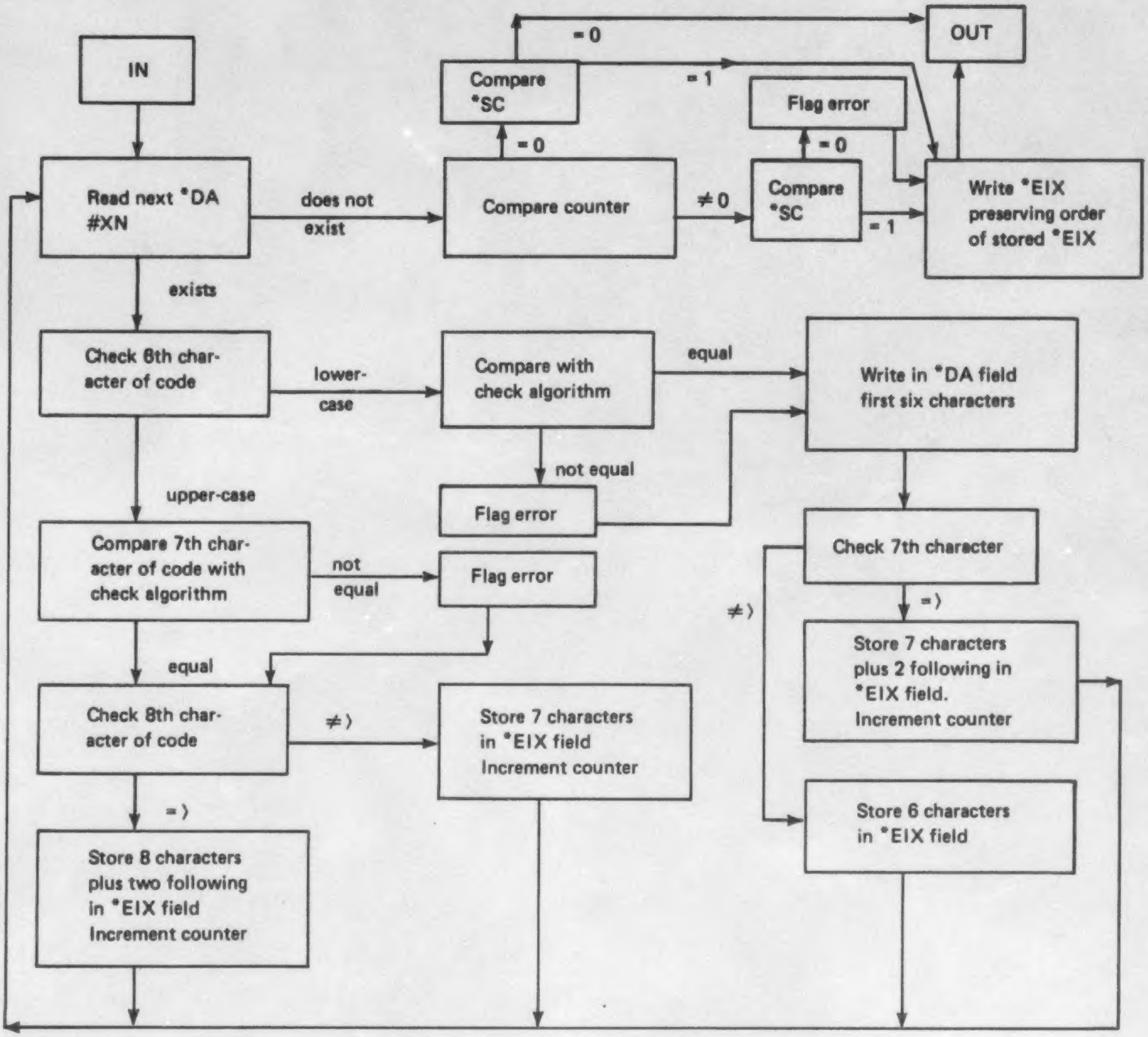
Initiator = X'5F'	1
ID	2
Data	Variable Length
Record Terminator = X'E0'	1

References

1. Physics and Astronomy Classification Scheme, American Institute of Physics, New York, N.Y. (1975)
2. Subject Headings for Engineering, Engineering Index, Inc., New York, N.Y. (1972)
3. John F. Tinker, Am. Doc. 17, 96-102 (1966)
4. Frances I. Hurwitz, Am. Doc. 20, 92-94 (1969)
5. William S. Cooper, Am. Doc. 20, 268-278 (1969)
6. Bibliographic Information Interchange on Magnetic Tape, ANSI Z39.2-1971, American National Standards Institute, New York, N.Y. (1971)
7. Reference Manual for Machine Readable Bibliographic Descriptions, UNISIST/ICU-AB Working Group on Bibliographic Descriptions, UNESCO, Paris (1974)
8. SPIN Technical Specifications, AIP-ID-72S, American Institute of Physics, New York, N.Y. (1972)
9. COMPENDEX, A Technical Guide, Engineering Index, Inc., New York, N.Y.
10. Chemical Abstracts Service Specifications Manual for Computer-Readable Files in Standard Distribution Format, Chemical Abstracts Service, Columbus, Ohio (1972)

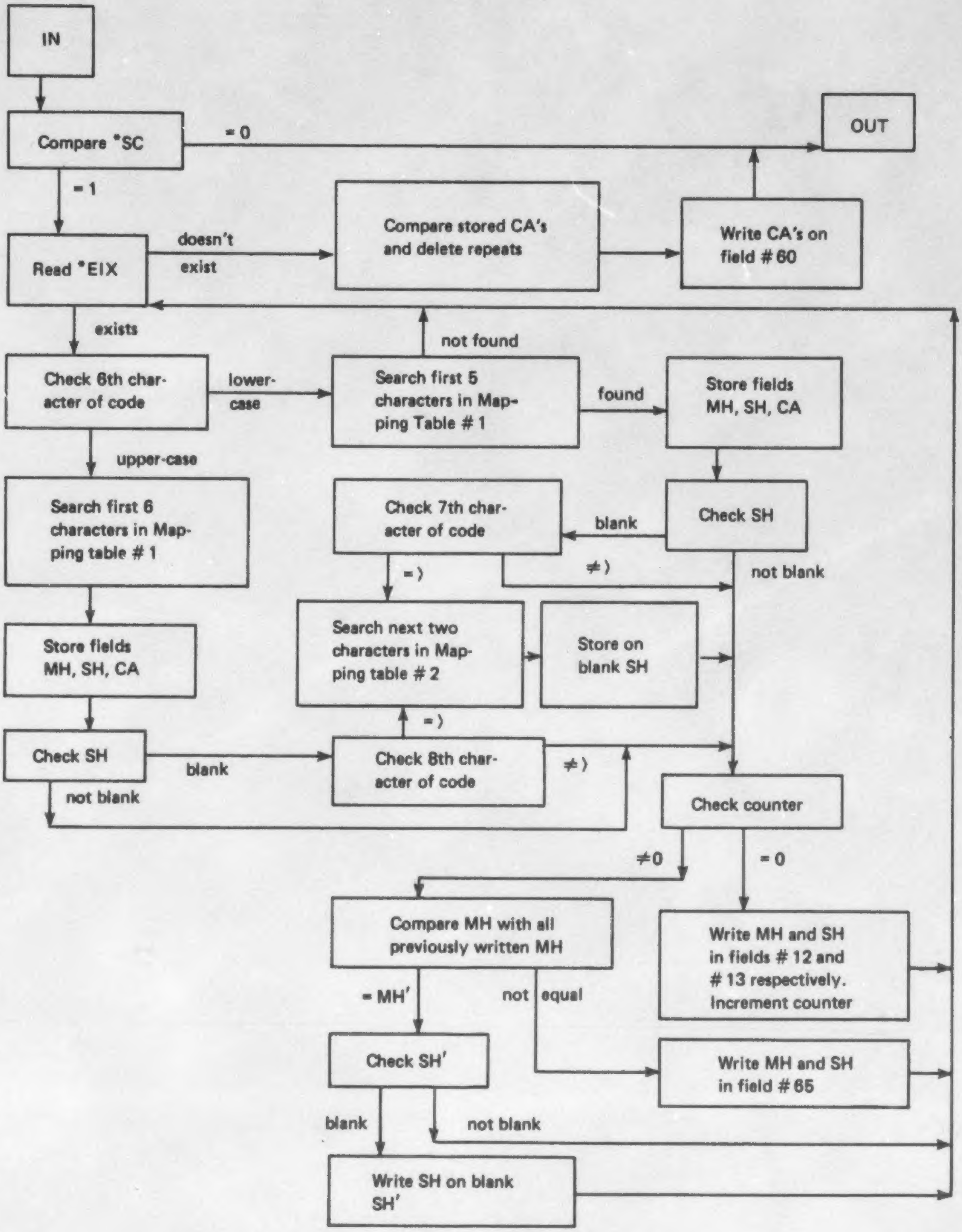
APPENDIX A

PURIFY-TYPE PROCESSOR


IN
Read next *DA #XN
does not exist
Compare counter
= 0
Compare *SC
= 0
= 1
OUT
≠ 0
Compare *SC
= 0
Flag error
= 1
Write *EIX preserving order of stored *EIX
exists
Check 6th character of code
lower-case
Compare with check algorithm
equal
Write in *DA field first six characters
not equal
Flag error
upper-case
Compare 7th character of code with check algorithm
not equal
Flag error
Check 7th character
=⟩
≠⟩
Store 7 characters plus 2 following in *EIX field. Increment counter
equal
Check 8th character of code
≠⟩
Store 7 characters in *EIX field Increment counter
=⟩
Store 8 characters plus two following in *EIX field Increment counter
Store 6 characters in *EIX field

APPENDIX B

AIP-EI CONVERTER


IN
Compare *SC
= 0
OUT
= 1
Read *EIX
doesn't exist
Compare stored CA's and delete repeats
Write CA's on field # 60
exists
not found
Check 8th character of code
lower-case
Search first 5 characters in Mapping Table # 1
found
Store fields MH, SH, CA
upper-case
Search first 6 characters in Mapping table # 1
Check 7th character of code
blank
Check SH
=)
≠)
not blank
Store fields MH, SH, CA
Search next two characters in Mapping table # 2
Store on blank SH
=)
Check SH
blank
Check 8th character of code
≠)
not blank
Check counter
≠ 0
= 0
Compare MH with all previously written MH
Write MH and SH in fields # 12 and # 13 respectively. Increment counter
= MH'
not equal
Check SH'
Write MH and SH in field # 65
blank
not blank
Write SH on blank SH'

APPENDIX C. PACS TO SHE MAPPING TABLE

01.10.C	SOCIETIES AND INSTITUTIONS	901
01.10.F	SOCIETIES AND INSTITUTIONS	901
01.10.H	SOCIETIES AND INSTITUTIONS	901
01.30.-	PHYSICS	931
01.30.C	PHYSICS	931
01.30.D	PHYSICS	931
01.30.F	PHYSICS	931
01.30.H	PHYSICS	931
01.40.-	EDUCATION	901
01.40.C	EDUCATION	901
01.40.E	EDUCATION	901
01.40.G	EDUCATION --Teaching	901
01.40.J	EDUCATION --Teaching	901
01.40.L	EDUCATION --Teaching	901
01.50.-	EDUCATION --Teaching	901
01.50.F	EDUCATION --Teaching	901
01.50.H	DATA PROCESSING --Educational Applications	723,901
01.50.K	EDUCATION --Teaching	901
01.50.M	EDUCATION --Demonstrations	901
01.50.P	EDUCATION --Demonstrations	901
01.50.Q	EDUCATION --Demonstrations	901
01.50.TA	COLLEGE BUILDINGS	901
01.50.TB	SCHOOL BUILDINGS	901
01.50.TC	LIBRARIES	901
01.60.+	PHYSICS	901
01.65.+	PHYSICS	901
01.70.+	PHYSICS	901
01.75.+	PHYSICS	901
01.80.+	PHYSICS	901
01.90.+	PHYSICS	901
02.10.-	MATHEMATICAL TECHNIQUES --Algebra	921
02.10.B	MATHEMATICAL TECHNIQUES --Algebra	921
02.10.C	MATHEMATICAL TECHNIQUES --Set Theory	921
02.10.E	MATHEMATICAL TECHNIQUES --Combinatorial Mathematics	921
02.10.G	MATHEMATICAL TECHNIQUES --Algebra	921
02.10.J	MATHEMATICAL TECHNIQUES --Algebra	921
02.10.L	MATHEMATICAL TECHNIQUES --Number Theory	921
02.10.N	MATHEMATICAL TECHNIQUES --Polynomials	921
02.10.P	MATHEMATICAL TECHNIQUES --Algebra	921
02.10.R	MATHEMATICAL TECHNIQUES --Algebra	921
02.10.SA	MATHEMATICAL TECHNIQUES --Linear Algebra	921
02.10.SB	MATHEMATICAL TECHNIQUES --Matrix Algebra	921
02.10.T	MATHEMATICAL TECHNIQUES --Algebra	921
02.10.V	MATHEMATICAL TECHNIQUES --Algebra	921
02.10.W	MATHEMATICAL TECHNIQUES --Algebra	921
02.20.-	MATHEMATICAL TECHNIQUES --Algebra	921
02.20.D	MATHEMATICAL TECHNIQUES --Algebra	921
02.20.F	MATHEMATICAL TECHNIQUES --Algebra	921
02.20.G	MATHEMATICAL TECHNIQUES --Algebra	921
02.20.H	MATHEMATICAL TECHNIQUES --Algebra	921
02.20.K	MATHEMATICAL TECHNIQUES --Algebra	921
02.20.M	MATHEMATICAL TECHNIQUES --Algebra	921
02.20.N	MATHEMATICAL TECHNIQUES --Algebra	921
02.20.R	MATHEMATICAL TECHNIQUES --Algebra	921
02.20.S	MATHEMATICAL TECHNIQUES --Algebra	921
02.20.T	MATHEMATICAL TECHNIQUES --Algebra	921
02.30.-	MATHEMATICAL TECHNIQUES --Algebra	921
02.30.B	MATHEMATICAL TECHNIQUES --Algebra	921
02.30.C	MATHEMATICAL TECHNIQUES --Integration	921

02.30.D	MATHEMATICAL TECHNIQUES --Poles and Zeros	921
02.30.E	MATHEMATICAL TECHNIQUES --Harmonic Analysis	921
02.30.F	MATHEMATICAL TECHNIQUES --Poles and Zeros	921
02.30.G	MATHEMATICAL TECHNIQUES	921
02.30.H	MATHEMATICAL TECHNIQUES --Differential Equations	921
02.30.J	MATHEMATICAL TECHNIQUES --Differential Equations	921
02.30.K	MATHEMATICAL TECHNIQUES --Difference Equations	921
02.30.L	MATHEMATICAL TECHNIQUES --Convergence of Numerical Methods	921
02.30.M	MATHEMATICAL TECHNIQUES --Convergence of Numerical Methods	921
02.30.N	MATHEMATICAL TECHNIQUES --Harmonic Analysis	921
02.30.P	MATHEMATICAL TECHNIQUES --Harmonic Analysis	921
02.30.QA	MATHEMATICAL TRANSFORMATIONS --Fast Fourier Transforms	921
02.30.QB	MATHEMATICAL TRANSFORMATIONS --Fourier Transforms	921
02.30.QC	MATHEMATICAL TRANSFORMATIONS --Laplace Transforms	921
02.30.QD	MATHEMATICAL TRANSFORMATIONS --Z Transforms	921
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.30	" - *6	"
.35	" - Velocity	"
.40	ACOUSTICS	"
.45	"	"
.50	"	"
.55	"	"
.60	"	"
.70	"	"
43.25.10	"	"
.15	"	"
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.30	ACOUSTIC WAVES - *6	"
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.45	NOISE, ACOUSTIC	"
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.70	NOISE ABATEMENT	"
.75	"	"
.80	"	"
.85	NOISE, ACOUSTIC	"

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.28	"	"
.35	"	"
.40	"	"
.42	"	"
.44	"	"
.48	"	"
.50	"	"
.52	"	"
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.48	"	"
.50	"	"
.52	"	"
.54	"	"
.56	ACOUSTIC GENERATORS	"
.60	LOUDSPEAKERS - *5	"
.62	MICROPHONES	"
.64	AUDIO SYSTEMS	"
.66	*8	"
.68	PHONOGRAPHS	"
.70	*8	"
.72	*8	"
.74	*8	"

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PACS SUPPLEMENT

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		MACHINE TOOLS - Ultrasonic	"
		METAL CLEANING - Ultrasonic	"
		SOUND MEASURING INSTRUMENTS	"
		ULTRASONIC APPLICATIONS	"
		ULTRASONIC DEVICES	"
		ULTRASONIC DELAYLINES	"
		ULTRASONIC EQUIPMENT	"
		ULTRASONICS - Measurements	"
		- Velocity Measurements	"
*2	Specify:	ULTRASONIC EFFECTS	753
		STERILIZATION	"
		STERILIZERS	"
*3	Specify:	ACOUSTICS LRBORATORIES	751
		CONTROL, ACOUSTIC VARIABLES	"
		TYPEWRITERS - Phonetic Actuzation	"
*4	Specify:	AUDIO EQUIPMENT	752
		AUDIO EQUIPMENT - Studios	"
		AUDIO EQUIPMENT - Testing	"
*5	Specify:	- Electrostatic Actuation	752
		- Manufacture	"
		- Testing	"
*6	Specify:	- Diffraction	751
		- Interference	"
		- Reflection	"
		- Refraction	"
		- Scattering	"
*7	Specify:	- Manufacture	752
		- Testing	"
*8	Specify:	SOUND RECORDING	752
		SOUND REPRODUCTION	"

PACS	SHE HEADINGS	CAL
43.70.62	VOCODERS	752
.65	SPEECH - Recognition	751
.70	SPEECH	"
.75	"	"
43.75.10	MUSICAL INSTRUMENTS	752
.20	"	"
.30	"	"
.35	"	"
.40	"	"
.45	"	"
.50	"	"
.55	"	"
.60	"	"
.65	"	"
.70	"	"
.75	"	"
.80	MUSICAL INSTRUMENTS, ELECTRONIC - *7	"
43.80.10	ACOUSTIC WAVE EFFECTS	751
.20	"	"
.30	"	"
.40	"	"
.45	"	"
.50	"	"
.60	"	"
.70	BIOMEDICAL EQUIPMENT	462
.75	" - Ultrasonic Effects	462,753
	ULTRASONIC EFFECTS	
43.85.10	*1	
.20	ACOUSTIC VARIABLES MEASUREMENT - Impedance	751
.22	" - Wave Velocity	"
.24	" - Intensity	"
.30	" - Standards	751,902
	STANDARDS	
.32	ACOUSTIC WAVES - Spectrum Analysis	751
.34	ACOUSTIC VARIABLES MEASUREMENT - Acoustic Field	"
.35	"	"
.36	SIGNAL DISTORTION - Measurement	"
.40	TRANSDUCERS	752
.42	ELECTROACOUSTIC TRANSDUCERS	"
.44	"	"
.46	"	"
.48	"	"
.50	"	"
.52	"	"
.54	"	"
.56	ACOUSTIC GENERATORS	"
.60	LOUDSPEAKERS - *5	"
.62	MICROPHONES	"
.64	AUDIO SYSTEMS	"
.66	*8	"
.68	PHONOGRAPHS	"
.70	*8	"
.72	*8	"
.74	*8	"

PACS	SHE HEADINGS	CAL
.76	EARPHONES	752
.78	*4	"
.79	PHONOGRAPH RECORDS - Stereophonic Recordings	"
.80	TELEVISION - Recording	751
.82	VOCODERS	752
.84	COMPUTERS	753,752
.86	AUDIOMETERS	461,941
.88	EAR PROTECTORS	914
.90	AIR NAVIGATION	431
.92	BIOMEDICAL EQUIPMENT - Acoustic Devices ACOUSTIC DEVICES	462,752

PACS SUPPLEMENT

*1	Specify:	FLOW METERS - Ultrasonic	753
		MACHINE TOOLS - Ultrasonic	"
		METAL CLEANING - Ultrasonic	"
		SOUND MEASURING INSTRUMENTS	"
		ULTRASONIC APPLICATIONS	"
		ULTRASONIC DEVICES	"
		ULTRASONIC DELAYLINES	"
		ULTRASONIC EQUIPMENT	"
		ULTRASONICS - Measurements	"
		- Velocity Measurements	"
*2	Specify:	ULTRASONIC EFFECTS	753
		STERILIZATION	"
		STERILIZERS	"
*3	Specify:	ACOUSTICS LRBORATORIES	751
		CONTROL, ACOUSTIC VARIABLES	"
		TYPEWRITERS - Phonetic Actuzation	"
*4	Specify:	AUDIO EQUIPMENT	752
		AUDIO EQUIPMENT - Studios	"
		AUDIO EQUIPMENT - Testing	"
*5	Specify:	- Electrostatic Actuation	752
		- Manufacture	"
		- Testing	"
*6	Specify:	- Diffraction	751
		- Interference	"
		- Reflection	"
		- Refraction	"
		- Scattering	"
*7	Specify:	- Manufacture	752
		- Testing	"
*8	Specify:	SOUND RECORDING	752
		SOUND REPRODUCTION	"

APPENDIX D. PACS OPTICS SUPPLEMENT

PACS 1975

Section 42. Optics

This version uses the following notation:

* before PACS code: calls the attention of the indexer to an entry within the PACS Supplement

> after PACS code: refers to the PACS Footnotes

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40. CLASSIFICATION FIELDS OF PHENOMENOLOGY AND THEIR APPLICATIONS

42. Optics *(for properties of gases and of liquids and solids see 51.70 and 78, respectively)*

	42.10.–s		**Propagation and transmission in homogeneous media**
	42.10.Dy		Wave-front and ray tracing
*	42.10.Fa		Edge and boundary effects, refraction
*	42.10.Hc		Diffraction and scattering from extended bodies
	42.10.Jd		Interference
	42.10.Ke		Absorption
	42.10.Mg		Coherence
	42.10.Nh		Polarization
	42.10.Qj		Propagation and transmission in homogeneous and anisotropic media, birefringence
	42.20.–y		**Propagation and transmission in inhomogeneous media**
	42.20.Cc		Wave front, ray tracing, and beam spread in random turbulent media
	42.20.Ee		Coherence in random turbulent media, scintillation
	42.20.Gg		Scattering from haze, fog, dust, etc. *(see also 42.68. Atmospheric optics)*
	42.30.–d		**Optical information, image formation and analysis**
	42.30.Di		Theory
	42.30.Fk		Aberrations
	42.30.Hn		Resolution
	42.30.Kq		Fourier transform optics
	42.30.Lr		Modulation and optical transfer functions
	42.30.Nt		Optical storage and retrieval
	42.30.Qw		Optical communications
*	42.30.Sy		Pattern recognition
	42.30.Va		Image processing and restoration
	42.40.–i		**Holography**
	42.40.Dp		General and theoretical
	42.40.Fr		Image characteristics
	42.40.Ht		Photographic and recording problems
	42.40.Kw		Holographic instrumentation and techniques
	42.40.My		Applications
	42.50.+q		**Quantum optics**
*	**42.55.+g**		**Masers**
	42.60.–v	>1	**Lasers**
	42.60.Cz	>1	Gas lasers
	42.60.Eb	>1	Liquid lasers and organic dye lasers
	42.60.Gd	>1	Solid lasers
	42.60.Jf	>1	Semiconductor lasers
	42.60.Lh	>1	Laser resonators, cavities, and modulators
	42.60.Nj	>1	Laser beam interactions and properties
	42.60.Qm	>1	Laser beam applications

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	42.65.−k		**Nonlinear optics**
	42.65.Dr		Stimulated Raman, photon echoes, parametric oscillations, and other interactions of radiation with matter
	42.65.Ft		Harmonic generation
	42.65.Hw		Beam trapping, self-induced transparency, and related effects
	42.66.−p		**Physiological optics, vision**
	42.66.Ct		Anatomy and optics of eye
	42.66.Ew		Nerve structure and function
	42.66.Gy		Physiology of eye
	42.66.Ja		Eye modulation transfer
	42.66.Lc		Light detection; adaptation and discrimination
	42.66.Ne		Color detection; adaptation and discrimination
	42.66.Qg		Scales for light and color detection
	42.66.Si		Psychophysics of vision, visual perception
	42.66.Tj		Binocular vision
	42.68.−w		**Atmospheric optics**
	42.68.Db		Propagation through the atmosphere, radiation transfer
	42.68.Fd		Attenuation, absorption
	42.68.Hf		Spectral energy distribution
	42.68.Kh		Spectral absorption
	42.68.Mj		Scattering, polarization
	42.68.Pm		Infrared propagation and absorption
	42.68.Rp		Laser beam propagation
	42.68.Sq		Image transmission and formation
	42.68.Tr		Modulation transfer
	42.68.Vs		Clouds, fog, haze
	42.68.Wt		Effects of air pollution
	42.70.−a		**Optical materials**
*	42.70.Ce		Glass
	42.70.Eg		Quartz
	42.70.Fh		Other optical materials
	42.70.Gi		Light-sensitive materials
*	**42.75.−r**		**Optical measurements and instrumentation**
	42.75.Dx	>2	Sources and standards
*	42.75.Fz		Colorimetry
	42.75.Hb	>2	Radiometry, photometry
			For interferometers and interferometry, see 07.40
			For spectrometers and spectroscopy, see 07.45
*	42.75.Kd		Refractometry, reflectometry
*	42.75.Le		Polarimetry
*	42.75.Ng		Detection of radiation (bolometers, photoelectric cells, IR detection)

[continued on next page]

★ 42.78.−b		**Optical lens and mirror systems**
42.78.Cf		Lens design
42.78.Dg		Optical system design *(see also 42.30. Image formation)*
42.78.Fi		Performance and testing of optical systems *(see also 42.85. Optical workshop techniques)*
42.78.Hk		Coatings
		For photographic, cinematographic, and television cameras, see 07.50.N
42.78.Mq	>2	Eyepieces
42.78.Ps	>2	Projection systems
42.78.Rv	>2	Prism systems
42.78.Tx	>2	Microscopes *(see also 07.42. Microscopy)*
42.78.Vy	>2	Telescopes
★ 42.80.−f	>2	**Optical devices, techniques, and applications**
42.80.Bi	>2	Spatial filters and zone plates
42.80.Cj		Spectral and other filters
42.80.Dk	>2	Monochromators
42.80.Em		Shutters, windows, diaphragms, deflectors
42.80.Fn		Gratings, échelles
42.80.Gp	>2	Prisms
42.80.Hq	>2	Beam splitters
42.80.Jr	>2	Collimators and autocollimators
42.80.Ks		Optical beam modulators
42.80.Lt	>2	Optical waveguides
42.80.Mv	>2	Fiber optics
42.80.Px	>2	Range finders
42.80.Qy		Image detector, converter, and intensifier
42.80.Sa		Optical communications devices
		For laser and maser instrumentation, see 42.55 and 42.60, respectively
		For holography, see 42.40
		For photography, see 07.50
42.82.+n		**Integrated optics**
42.85.−x		**Optical testing and workshop techniques**
42.85.Dc		Surface grinding, fabrication
42.85.Fe		Optical testing techniques
42.90.+m		**Other topics in optics**

PACS Footnotes

>1	Specify when pertinent:	>1B	Accessories
		>1C	Manufacture
		>1D	Modes
		>1E	Optical Pumping
		>1F	Q-switching
		>1G	Resonators
		>1H	Testing
		>1J	Theory
>2	Specify when pertinent:	>2B	Accessories
		>2C	Diffusers
		>2D	Display Systems
		>2E	Filters (as accessories)
		>2F	Fungus Protection
		>2G	Infrared
		>2H	Lenses (as accessories)
		>2J	Light Sources (as accessories)
		>2K	Reflectors
		>2L	Temperature Control
		>2M	Ultraviclet

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42.10.F	Specify:	42.10.FB	Refraction
		42.10.FC	Reflection
		42.10.FD	Diffraction
42.10.H	Specify:	42.10.HB	Diffraction
		42.10.HC	Scattering
42.30.S	Specify:	42.30.SB	Pattern recognition systems
		42.30.SC	Character recognition
		42.30.SD	Character recognition, optical
42.55.+	Specify:	42.55.C	Cooling
		42.55.D	Manufacture
		42.55.E	Noise
		42.55.F	Testing
42.70.C	Specify:	42.70.CC	Light control
		42.70.CD	Optical quality
		42.70.CE	Photosensitive
42.75.-	Specify:	42.75.-B>2	Densitometers
		42.75.-C>2	Diffractometers
		42.75.-D>2	Gloss Measurement
		42.75.-E>2	Nephelometers
		42.75.-F>2	Optometers
		42.75.-G>2	Pyrometers
		42.75.-H>2	Turbidimeters
42.75.F	Specify:	42.75.FB	Color matching
		42.75.FC	Color terminology
		42.75.FD	Colorimeters
		42.75.FE	Colorimetry
42.75.K	Specify:	42.75.KB>2	Reflectometers
		42.75.KC>2	Refractometers

42.75.L	Specify:	42.75.LB>2	Polarimeters
		42.75.LC>2	Polariscopes
42.75.N	Specify:	42.75.NB>2	Bolometers
		42.75.NC>2	Infrared detectors
		42.75.ND>2	Radiometers
42.78.-	Specify:	42.78.-B>2	Mirrors
		42.78.-C>2	Lenses
42.80.-	Specify:	42.80.-B>2	Optical instruments
		42.80.-D>2	Binoculars
		42.80.-E>2	Comparators
		42.80.-F>2	Fluorescent screens
		42.80.-G>2	Guns--Sights
		42.80.-H>2	Light--Optical Resonators
		42.80.-J>2	Light--Pulse Generators
		42.80.-K>2	Luminescent devices
		42.80.-L>2	Stroboscopes
		42.80.-M>2	Surveying instruments
		42.80.-N>2	Transducers

APPENDIX E. CONVERSION OF AIP-EI INDEXING FOR OPTICS

A manual, simulated run of the system proposed for the Conversion of AIP to EI indexing was conducted. The subject was restricted to Optics, as defined by the scope of Section 42 in PACS. The indexing already done by AIP and EI for the January and February 1975 issues of the Journal of the Optical Society of America and for the January 1975 issue of the Journal of Applied Optics was used, supplemented where necessary by the auxiliary indexing described elsewhere.

After excluding those papers falling outside the scope of Section 42, a total of 62 papers remained for the experiment. The results were scored according to two criteria:

a) Strict; absolute coincidence of terms

b) Broad; close coincidence which may be counted as a satisfactory match for all practical purposes

The following is a short discussion of the results, using scores based on the practical criterion b). After conversion, half of the papers (50%) resulted in indexing totally identical to that of EI, i.e., coinciding in main headings, cross-references and CAL codes. On the other hand, 70% of the papers coincided at the main headings, which are the most important indexing element for EI; 87% had one or more coincidences at the subject headings, and 90% had one or more coincidences at the CAL code level.

It is interesting to note that the indexing policies are very similar at AIP and EI, since a total of 95 subject headings and 94 CAL codes resulted from AIP's assignments, compared to 103 and 111, respectively, assigned by EI. Of the headings assigned by AIP, 69% coincided with 64% of those assigned by EI. Similarly, 78% of the CAL codes resulting from the conversion coincided with 66% of those assigned by EI.

These results are quite encouraging. Some minor improvements may be expected from further study and adjustments to the system; residual disagreements are unavoidable, resulting from differences in judgment by indexers. Inspection of the eight papers with no coincidence at all (13%0 of the total) revealed that they were difficult to index, since they did not fit the classification system. Solving this problem becomes a matter of personal judgment, and discrepancies have nothing to do with the performance of the conversion system. Exclusion of this set of ambiguous papers will raise the percentages mentioned above to 57%, 79%, 100%, 96%, 80%, 73%, 85% and 75% respectively. These numbers are well beyond the agreement to be expected for indexing done by two independent teams using the same classification system, as demonstrated, for example, in a previous study of AIP-INSPEC indexing.